CLAIMS

What is claimed is:

1. A method of pattern recognition comprising:

generating a hologram of a reference object;

generating a hologram of an input object; and

correlating the hologram of the reference object with the hologram of the input object to generate a set of correlation peaks.

2. The method as set forth in Claim 1 further comprising analyzing the set of correlation peaks generated by the correlation of the hologram of the reference object with the hologram of the input object wherein the presence of a correlation peak indicates similarity between the reference object and the input object and wherein the lack of the presence of a correlation peak indicates dissimilarity between the reference object and the input object.

3. The method as set forth in Claim 1 further comprising recording the hologram of the reference object.

4. The method as set forth in Claim 1 further comprising recording the hologram of the input object.

5. The method as set forth in Claim 1 wherein the correlating of the hologram of the reference object with the hologram of the input object comprises:

transforming the hologram of the reference object;

transforming the hologram of the input object; and

multiplying the transformation of the hologram of the reference object by the transformation of the hologram of the input object.

6. The method as set forth in Claim 5 wherein the transforming of the hologram of the reference object comprises Fourier transforming the hologram of the reference object and wherein transforming the hologram of the input object comprises Fourier transforming the hologram of the input object.

7. The method as set forth in Claim 6 further comprising transforming the multiplication of the transformation of the hologram of the reference object and the transformation of the hologram of the input object.

8. A method of pattern recognition comprising:

generating a hologram of a reference object;

generating a hologram of an input object;

defining a window within the hologram of the input object;

correlating the hologram of the reference object with the window defined within the hologram of the input object to generate a set of correlation peaks.

9. The method as set forth in Claim 8 further comprising analyzing the set of correlation peaks generated by the correlation of the hologram of the reference object with the window defined within the hologram of the input object wherein the presence of a correlation peak indicates similarity between the reference object and the input object and wherein the lack of the presence of a correlation peak indicates dissimilarity between the reference object and the input object.

10. The method as set forth in Claim 8 further comprising recording the hologram of the reference object.

11. The method as set forth in Claim 8 further comprising recording the hologram of the input object.

12. The method as set forth in Claim 8 wherein the correlating of the hologram of the reference object with the window within the hologram of the input object comprises:

transforming the hologram of the reference object;

transforming the window defined within the hologram of the input object; and

multiplying the transformation of the hologram of the reference object by the transformation of the window defined within the hologram of the input object.

13. The method as set forth in Claim 12 wherein the transforming of the hologram of the reference object comprises Fourier transforming the hologram of the reference object and wherein transforming the window within the hologram of the input object comprises Fourier transforming the window within the hologram of the input object.

14. The method as set forth in Claim 13 further comprising transforming the multiplication of the transformation of the hologram of the reference object and the transformation of the window defined within the hologram of the input object.

15. The method as set forth in Claim 8 wherein the defining of a window within the hologram of the input object comprises defining a window according to the equation

$$H_p'(m,n;a_x,a_y) = H_p(m,n)rect\left(\frac{m-a_x}{b_x}, \frac{n-a_y}{b_y}\right),$$

wherein $H_p'(m,n;a_x,a_y)$ is the defined window, $rect\left(\frac{m-a_x}{b_x}, \frac{n-a_y}{b_y}\right)$ is the rectangle function, $H_p(m,n)$ is the hologram of the reference object, a_x is the location of the center of the window in the x direction, a_y is the location of the center of the window in the y direction, b_x is width of the window in the x direction, and b_y is width of the window in the y direction.

16. A storage medium encoded with a set of data created by:

generating a hologram of a reference object;

generating a hologram of an input object; and

correlating the hologram of the reference object with the hologram of the input object to generate a set of correlation peaks.

17. The storage medium as set forth in Claim 16 further comprising analyzing the set of correlation peaks generated by the correlation of the hologram of the reference object with the hologram of the input object wherein the presence of a correlation peak indicates similarity between the reference object and the input object and wherein the lack of the presence of a correlation peak indicates dissimilarity between the reference object and the input object.

18. The storage medium as set forth in Claim 16 wherein the generating of the hologram of the reference object includes recording the hologram of the reference object.

19. The storage medium as set forth in Claim 16 wherein the generating of the hologram of the input object includes recording the hologram of the input object.

20. The storage medium as set forth in Claim 16 wherein the correlating of the hologram of the reference object with the hologram of the input object comprises:

transforming the hologram of the reference object;

transforming the hologram of the input object; and

multiplying the transformation of the hologram of the reference object by the transformation of the hologram of the input object.

21. The storage medium as set forth in Claim 20 wherein the transforming of the hologram of the reference object comprises Fourier transforming the hologram of the reference object.

22. The storage medium as set forth in Claim 20 wherein the transforming of the hologram of the input object comprises Fourier transforming the hologram of the input object.

23. A storage medium encoded with a set of data created by:

generating a hologram of a reference object;

generating a hologram of an input object;

defining a window within the hologram of the input object;

correlating the hologram of the reference object with the window within the hologram of the input object to generate a set of correlation peaks.

24. The storage medium as set forth in Claim 23 further comprising analyzing the set of correlation peaks generated by the correlation of the hologram of the reference object with the hologram of the input object wherein the presence of a correlation peak indicates similarity between the reference object and the input object and wherein the lack of the presence of a correlation peak indicates dissimilarity between the reference object and the input object.

25. The storage medium as set forth in Claim 23 wherein the generating of the hologram of the reference object includes recording the hologram of the reference object.

26. The storage medium as set forth in Claim 23 wherein the generating of the hologram of the input object includes recording the hologram of the input object.

27. The storage medium as set forth in Claim 23 wherein the correlating of the hologram of the reference object with the window within the hologram of the input object comprises:

transforming the hologram of the reference object;

transforming the window within the hologram of the input object; and

multiplying the transformation of the hologram of the reference object by the transformation of the window within the hologram of the input object.

28. The storage medium as set forth in Claim 27 wherein the transforming of the hologram of the reference object comprises Fourier transforming the hologram of the reference object.

29. The storage medium as set forth in Claim 27 wherein the transforming of the window within the hologram of the input object comprises Fourier transforming the window within the hologram of the input object.

30. The storage medium as set forth in Claim 23 wherein the defining of a window within the hologram of the input object comprises defining a window according to the equation

$$H_p'(m,n;a_x,a_y) = H_p(m,n) rect\left(\frac{m-a_x}{b_x}, \frac{n-a_y}{b_y}\right),$$

wherein $H_p'(m,n;a_x,a_y)$ is the defined window, $rect\left(\frac{m-a_x}{b_x}, \frac{n-a_y}{b_y}\right)$ is the rectangle function, $H_p(m,n)$ is the hologram of the reference object, a_x is the location of the center of the window in the x direction, a_y is the location of the center of the window in the y direction, b_x is width of the window in the x direction, b_y is width of the window in the y direction.

31. The method as set forth in Claim 7 further comprising taking the absolute value of the transformation of the multiplication of the transformation of the hologram of the reference object by the transformation of the hologram of the input object.

32. The method as set forth in Claim 31 further comprising squaring the absolute value of the transformation of the multiplication of the transformation of the hologram of the reference object by the transformation of the hologram of the input object according to the equation

$$C_{OP}(x,y;a_x,a_y;a_x',a_y') = \left|F^{-1}\left\{F\left[H_O'(x,y;a_x,a_y)\right]\times F^*\left[H_P'(x,y;a_x',a_y')\right]\right\}\right|^2$$

wherein $C_{OP}(x,y;a_x,a_y;a_x',a_y')$ is the intensity of the correlation of the hologram of the reference object with the hologram of the input object, $H_O'(x,y;a_x,a_y)$ is the hologram of the reference object, $H_P'(x,y;a_x',a_y')$ is the window defined within the hologram of the input object, F indicates a transformation, F^{1} indicates an inverse transformation and F^* indicates a complex transformation.

33. The method as set forth in Claim 14 further comprising taking the absolute value of the transformation of the multiplication of the transformation of the hologram of the reference object by the transformation of the hologram of the input object.

34. The method as set forth in Claim 33 further comprising squaring the absolute value of the transformation of the multiplication of the transformation of the hologram of the reference object by the transformation of the hologram of the input object according to the equation

$$C_{OP}(x,y;a_x,a_y;a_x',a_y') = \left|F^{-1}\left\{F\left[H_O'(x,y;a_x,a_y)\right]\times F^*\left[H_P'(x,y;a_x',a_y')\right]\right\}\right|^2$$

wherein $C_{OP}(x,y;a_x,a_y;a_x',a_y')$ is the intensity of the correlation of the hologram of the reference object with the hologram of the input object, $H_O'(x,y;a_x,a_y)$ is the hologram of the reference object, $H_P'(x,y;a_x',a_y')$ is the window defined within the hologram of the input object F indicates a transformation, F^{1} indicates an inverse transformation and F^* indicates a complex transformation.

35. The method as set forth in Claim 32 wherein *F* indicates a Fourier transformation.

36. The method as set forth in Claim 34 wherein *F* indicates a Fourier transformation.

37. The method as set forth in Claim 3 wherein the recording of the hologram of the reference object includes digitally recording the hologram of the reference object.

38. The method as set forth in Claim 37 wherein the digitally recording of the hologram of the reference object comprises storing the hologram of the reference object in a computer readable storage medium.

39. The method as set forth in Claim 4 wherein the recording of the hologram of the input object includes digitally recording the hologram of the input object.

40. The method as set forth in Claim 39 wherein the digitally recording of the hologram of the input object comprises storing the hologram of the input object in a computer readable storage medium.

41. The method as set forth in Claim 10 wherein the recording of the hologram of the reference object includes digitally recording the hologram of the reference object.

42. The method as set forth in Claim 41 wherein the digitally recording of the hologram of the reference object includes storing the hologram of the reference object in a computer readable storage medium.

43. The method as set forth in Claim 11 wherein the recording of the hologram of the input object includes digitally recording the hologram of the input object.

44. The method as set forth in Claim 43 wherein the digitally recording of the hologram of the input object includes storing the hologram of the input object in a computer readable storage medium.

45. The method as set forth in Claim 15 further comprising applying a phase factor, $\exp\left[i2\pi\left(a_x m + a_y n\right)\right]$, to the window defined within the hologram of the input object.

46. A method of determining a change in a kinematic property of an object, the method comprising:

generating a first hologram of the object;

generating a second hologram of the object; and

correlating the first hologram with the second hologram, to generate a set of correlation peaks.

47. The method as set forth in Claim 46 further comprising analyzing the set of correlation peaks wherein the presence of a correlation peak indicates a change in a kinematic property of the object and wherein the lack of the presence of a correlation peak indicates no change in the change in a kinematic property of the object.

48. A method of determining the change in a kinematic property of an object, the method comprising:

generating a first hologram of the object;

defining a first window within the first hologram of the object;

generating a second hologram of the object;

defining a second window within the second hologram of the object;

correlating the first window and the second window to generate a set of correlation peaks.

49. The method as set forth in Claim 46 further comprising autocorrelating the first hologram and comparing the autocorrelation of the first hologram with the correlation of the first hologram with the second hologram.

50. The method as set forth in Claim 48 further comprising analyzing the correlation peaks wherein the presence of a correlation peak indicates a change in a kinematic property of the object and wherein the lack of the presence of a correlation peak indicates no change in the kinematic property of the object.

51. The method as set forth in Claim 1 wherein the reference object comprises an optical image, a digitized image, a one dimensional set of data, a two dimensional set of data, a multi-dimensional set of data, an electrical signal, an optical signal, a two-dimensional phase object, a multi-dimensional phase object or a color object.

52. The method as set forth in Claim 1 wherein the input object comprises an optical image, a digitized image, a one dimensional set of data, a two dimensional set of data, a multi-dimensional set of data, an electrical signal, an optical signal, a two-dimensional phase object, a multi-dimensional phase object or a color object.

53. The method as set forth in Claim 1 further comprising conveying the hologram of the reference object to a remote location over a distributed computer network.

54. The method as set forth in Claim 1 further comprising conveying the hologram of the input object to a remote location over a distributed computer network.

55. The method as set forth in Claim 1 further comprising conveying the correlation of the hologram of the reference object with the hologram of the input object to a remote location over a distributed computer network.

56. The method as set forth in Claim 8 further comprising conveying the hologram of the input object to a remote location over a distributed computer network.

57. The method as set forth in Claim 8 further comprising conveying the hologram of the reference object to a remote location over a distributed computer network.

58. The storage medium as set forth in Claim 8 further comprising conveying the correlation of the hologram of the reference object with the window defined within the hologram of the input object to a remote location over a distributed computer network.

59. The storage medium as set forth in Claim 23 further comprising conveying the hologram of the input object to a remote location over a distributed computer network.

60. The storage medium as set forth in Claim 23 further comprising conveying the hologram of the reference object to a remote location over a distributed computer network.

61. The storage medium as set forth in Claim 23 further comprising conveying the correlation of the hologram of the reference object with the window within the hologram of the input object to a remote location over a distributed computer network.

62. The method as set forth in Claim 1 further comprising processing the hologram of the reference object by image compression of the hologram.

63. The method as set forth in Claim 62 further comprising conveying the compressed hologram to remote locations over a distributed computer network.

64. The method as set forth in Claim 1 further comprising processing the hologram of the input object by image compression of the hologram.

65. The method as set forth in Claim 64 further comprising conveying the compressed hologram to remote locations over a distributed computer network.

66. The method as set forth in Claim 62 further comprising processing the compressed hologram of the reference object by image decompression of the hologram.

67. The method as set forth in Claim 64 further comprising processing the compressed hologram of the input object by image decompression of the hologram.

68. A system for performing pattern recognition, the apparatus comprising:

a light source for generating an optical beam;

means for dividing the optical beam into a reference beam and an object beam;

means for introducing a phase shift between the reference beam and the object beam;

an object positioned within the object beam;

a beam combiner for combining the reference beam and the object beam; and

a detector for detecting the combination of the reference beam and the object beam.

69. The system as set forth in Claim 68 wherein the detector comprises a computer addressable detector.

70. The system as set forth in Claim 69 wherein the detector is connected to a distributed computer network.

71. The system as set forth in Claim 70 wherein the detector is connected to an electrically or optically addressable spatial light modulator.

72. The system as set forth in Claim 68 wherein the object comprises a two-dimensional or three-dimensional phase object, a color object, an original set of data comprising an optical image, a digitized image, a computer generated image, a one dimensional set of data or multi-dimensional set of data, an electrical signal or an optical signal.

73. The system as set forth in Claim 68 wherein the light source is a source of infrared light.

74. The method as set forth in Claim 8 wherein the reference object comprises an optical image, a digitized image, a one dimensional set of data, a two dimensional set of data, a multi-dimensional set of data, an electrical signal, an optical signal, a two-dimensional phase object, a multi-dimensional phase object or a color object.

75. The method as set forth in Claim 8 wherein the input object comprises an optical image, a digitized image, a one dimensional set of data, a two dimensional set of data, a multi-dimensional set of data, an electrical signal, an optical signal, a two-dimensional phase object, a multi-dimensional phase object or a color object.

76. The method as set forth in Claim 46 wherein the reference object comprises an optical image, a digitized image, a one dimensional set of data, a two dimensional set of data, a multi-dimensional set of data, an electrical signal, an optical signal, a two-dimensional phase object, a multi-dimensional phase object or a color object.

77. The method as set forth in Claim 46 wherein the input object comprises an optical image, a digitized image, a one dimensional set of data, a two dimensional set of data, a multi-dimensional set of data, an electrical signal, an optical signal, a two-dimensional phase object, a multi-dimensional phase object or a color object.

78. The method as set forth in Claim 48 wherein the reference object comprises an optical image, a digitized image, a one dimensional set of data, a two dimensional set of data, a multi-dimensional set of data, an electrical signal, an optical signal, a two-dimensional phase object, a multi-dimensional phase object or a color object.

79. The method as set forth in Claim 48 wherein the input object comprises an optical image, a digitized image, a one dimensional set of data, a two dimensional set of data, a multi-dimensional set of data, an electrical signal, an optical signal, a two-dimensional phase object, a multi-dimensional phase object or a color object.

80. The system as set forth in Claim 68 wherein the detector comprises a photorefractive material.

81. The method as set forth in Claim 1 wherein correlating the hologram of the reference object with the hologram of the input object comprises:

displaying the holograms of the input object and the reference object on electrically or optically addressable spatial light modulators;

addressing the electrically or optically addressable spatial light modulators with a reference beam; and

processing the holograms optically to generate a set of correlation peaks.

82. The method as set forth in Claim 8 wherein correlating the hologram of the reference object with the window defined within the hologram of the input object comprises:

displaying the window defined within the hologram of the input object and the hologram of the reference object on electrically or optically addressable spatial light modulators;

addressing the electrically addressable spatial light modulator with a reference beam; and

processing the holograms optically to generate a set of correlation peaks.

83. The method as set forth in Claim 1 wherein correlating the hologram of the reference object with the hologram of the input object comprises:

forming the holograms of the input object and the reference object on electrically or optically addressable spatial light modulators;

addressing the optically addressable spatial light modulator with a reference beam; and

processing the holograms optically to generate a set of correlation peaks.

84. The method as set forth in Claim 8 wherein correlating the hologram of the reference object with the window defined within the hologram of the input object comprises:

forming the window defined within the hologram of the input object and the hologram of the reference object on electrically or optically addressable spatial light modulators;

addressing the electrically or optically addressable spatial light modulators with a reference beam; and

processing the holograms optically to generate a set of correlation peaks.